

CLAIMS

What is claimed is:

- 1 1. A microelectromechanical device, comprising
 - 2 a. a rotating element including a first electrode;
 - 3 b. a vertical stop disposed proximate the rotating
 - 4 element;
 - 5 c. a second electrode;
 - 6 d. means, coupled to the first and second electrodes
 - 7 for measuring a capacitance between them; and
 - 8 e. means coupled to the capacitance sensing means for
 - 9 determining from the capacitance a digital control
 - 10 state of the device.
- 1 2. The device of claim 1 further comprising means for
- 2 determining a deviation from a desired control
- 3 state.
- 1 3. The device of claim 1 wherein the element has two
- 2 control states.
- 1 4. The device of claim 1, further comprising means for
- 2 rotating the rotatable element.
- 1 5. The device of claim 1 wherein the element is a MEMS
- 2 mirror.

- 1 6. A microelectromechanical system (MEMS) apparatus,
2 comprising
3 a. an element configured to rotate between a first
4 control state and a second control state;
5 b. a vertical stop disposed proximate the element;
6 c. one or more electrodes disposed proximate the
7 element, wherein a capacitance between the element
8 and the one or more electrodes has a first value
9 when the element is in the first control state and
10 the capacitance has a second value when the element
11 is in the second control state;
12 d. means, for measuring a value of the capacitance
13 between the element and the at least one of the one
14 or more electrodes; and
15 e. means coupled to the capacitance sensing means for
16 determining a control state of the element from the
17 value of the capacitance.
- 1 7. The device of claim 6 wherein the first and second
2 angular positions are substantially 90° apart.
- 1 8. The device of claim 6 further comprising means for
2 actuating the element.

1 9. The device of claim 6 further comprising means for
2 electrostatically clamping the element in at least one of
3 the first and second positions.

1 10. The device of claim 9, wherein the clamping
2 means comprises a clamping voltage source
3 electrically coupled to one or more of the one
4 or more electrodes.

1 11. The device of claim 6, further comprising a
2 substrate, wherein the element connected to the
3 substrate by a hinge.

1 12. The device of claim 11, wherein the one or more
2 electrodes includes an electrode disposed on
3 the substrate proximate the element.

1 13. The device of claim 11, wherein the substrate
2 includes a vertical stop disposed proximate the
3 element.

1 14. The device of claim 13, wherein the one or more
2 electrodes includes an electrode attached to
3 the vertical stop.

1 15. The device of claim 6, wherein the element is a MEMS
2 mirror.

1 16. A method for sensing the control state of a
2 microelectromechanical device, comprising:
3 measuring a value of a capacitance between a rotatable
4 element and one or more of a first and second electrode
5 disposed proximate the rotatable element to determine
6 whether the rotatable element is in a first control
7 state, a second control state, or neither the first nor
8 second control state,
9 wherein the rotatable element is in a vertical position
10 proximate a vertical stop when the rotatable element is
11 in the first or second control state.

1 17. The method of claim 16, further comprising applying
2 an electrostatic clamping voltage to one or more of
3 the first and second electrodes.

1 18. The method of claim 17, wherein the clamping
2 voltage is a DC voltage and c) includes
3 superimposing an AC signal on the clamping
4 voltage.

1 19. The method of claim 17, wherein the clamping
2 voltage and a sensing signal are alternately
3 applied in time.

1 20. The method of claim 16 further comprising
2 determining the presence of a fault in the

3 microelectromechanical device from the value of the
4 capacitance.

1 21. The method of claim 16 further comprising using the
2 value of the capacitance to time the actuation of
3 the element.

1 22. An optical communications system, comprising:

2 a) one or more input optical fibers;

3 b) one or more output optical fibers;

4 c) a microelectromechanical system (MEMS) optical
5 switch including:

6 i) one or more MEMS mirrors configured to rotate
7 between a first angular position and a second
8 angular position;

9 ii) b. a vertical stop disposed proximate one or
10 more of the MEMS mirrors;

11 iii) one or more electrodes disposed proximate each
12 of the one or more mirrors, wherein a
13 capacitance between the mirrors and the
14 electrodes has a first value when the mirrors
15 are in a first control state and the
16 capacitance has a second value when the element
17 is in a second control state;

18 iv) means, for measuring a value the capacitance
19 between at least one of the one or more mirrors

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20 and the at least one of the one or more
21 electrodes; and
22 v) means coupled to the capacitance sensing means
23 for determining a control state of the element
24 from the value of the capacitance.